Specifications for Side Fire Radar Vehicle Sensing System

Requisition Number - G15-003697

The Radar Vehicle Sensing Device (RSVD) shall be a non-intrusive device, shall be easy to install and shall automatically configure up to ten lanes of traffic by automatically determining lane boundaries and detection thresholds. It shall utilize a digitally generated, modulated signal to accurately detect vehicle volume, speed and occupancy in all weather conditions without performance degradation, and the device shall operate accurately in both side-fire and forward-fire installations. The RVSD shall be remote accessible; it shall provide multiple connectivity options for easy integration into our existing Traffic Data Retrieval System (TDRS), and it shall support a variety of data protocols. The RVSD shall be manufactured to the strictest industry standards, and shall utilize automated assembly processes to ensure product quality and minimize the risk of failure due to error. The manufacturer shall thoroughly train installers and operators to ensure accurate RVSD performance. Externally, the RVSD shall be modular in design to facilitate easy installation and replacement in the field. The total weight of the RVSD shall not exceed five lbs. All external parts shall be made of corrosion resistant material, and all materials shall be protected from fungus growth and moisture deterioration.
Field units must have an onboard real time clock calendar. The clock must be a twenty-four (24) hour time clock with hours, minutes and seconds. The calendar must output the day, month and year, compensating for leap year. The recording interval must be selectable between 1 and 1440 minutes.

The RVSD shall perform auto-configuration for up to ten lanes of traffic simultaneously. In this configuration process, the RVSD shall automatically determine lane boundaries and detection thresholds for lanes that have free-flowing traffic, and shall automatically tune-out stationary detections such as barriers and medians. Documentation that demonstrates the auto-configuration process shall be provided.

Sensor Performance. The RVSD shall provide accurate, real-time volume, average speed and occupancy data, and detections shall be correctly categorized into a minimum of four length-based classifications. True vehicle detections shall occur within a range of 9' to 250' from the RVSD.

The RVSD shall maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light. The device shall not rely on look-up table based temperature compensation circuitry as variation across parts and over time cause errors in the compensation. The sensor shall be capable of continuous operation over an ambient temperature range from -40° F (-40° C) to 170° F (75° C), and a relative humidity range from five percent to 95 percent (non-condensing). RVSD operation shall continue in rain to 4 inch (10 cm) per hour.

Volume data shall be accurate within five percent of truth for any direction of travel and individual lane accuracy shall be within 10 percent of truth during normal conditions at the installed location.

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Individual Vehicle Speed data shall be accurate within four mph for at least 90% of the vehicles.

Average Speed data shall be within 1 mph when at least 25 vehicles are included in an interval.

Classification data shall be accurately determined for 90 percent of detected vehicles during free flow conditions. The same accuracy shall be achieved for detected vehicles in congestion when commercial truck traffic is less than 5%. Vehicles shall be separated into a minimum of four user-definable length based classifications. Test data verifying this performance shall be provided.

To achieve the specified accuracy in a variety of conditions the range resolution shall not be larger than 10 feet null to null and 4 feet at the half power level. This requires that the RVSD shall have a minimum functional bandwidth of 240 MHz. This reduces the problem of vehicle responses getting drowned out by brighter vehicles in adjacent lanes and improves performance for moving and stopped vehicles near barriers.

Performance Maintenance. The RVSD shall not require cleaning or adjustment to maintain performance. It shall not rely on battery backup to store configuration information. Once the sensor is calibrated, it shall not need recalibration to maintain performance unless the roadway configuration changes. In that case, the RVSD's remote connectivity shall allow operators to reconfigure and recalibrate the sensor automatically.

Mounting Assembly. A mounting assembly will be provided to allow the RVSD to be mounted directly onto a mounting assembly fastened to a pole, overhead mast-arm or other solid structure. The mounting assembly shall provide the necessary degrees of rotation to ensure proper installation. It shall be constructed of weather resistant materials and shall be able to support a 20 lb. load. The RVSD will be mounted with its cable connector pointing towards the ground and tilted so that the RVSD is aimed at the center of the lanes to be monitored. Typically, the RVSD will be tilted off of vertical by 10 to 20 degrees. The RVSD will be aligned so that the side-to-side (azimuth) angle is within approximately ±2° of perpendicular to the flow of traffic. Software shall be available to verify the accuracy of the azimuth pointing angle.

The RVSD shall be supplied with a connector cable of the appropriate length for each installation site. The connector shall meet the MIL-C-26482 specification. The backshell shall be an environmentally sealed shell that offers excellent immersion capability, and designed to interface with the appropriate MIL-C-26482 connector. All conductors that interface with the connector shall be encased in a single jacket and the outer diameter of this jacket shall be within the backshell's cable O.D. range to ensure proper sealing. The backshell shall have a clamp bar style strain relief with enough strength to support the cable slack under extreme weather conditions. Recommended

connectors are Cannon's KPT series, and recommended backshells are Glenair Series 37 cable sealing backshells. The MIL-C-26482 connector shall provide contacts for all data and power connection.

Lightning Surge Protection. Lightning surge protection will be provided that meets or exceeds the EN 61000-4-5 Class 4 specifications. This protection will be installed no farther than 40 feet along the RVSD cable from the RVSD unit. To ensure the continued operation of the RVSD in the presence of electrical surges, all connections to the RVSD shall be protected including power, RS-232, RS-485 communication lines and ground.

Communication. The RVSD shall provide two or more communication ports that can be accessed simultaneously using any RVSD-supported protocol. This will enable multiple operators to collect data from the RVSD at the same time without interrupting or interfering with each other. The RVSD shall provide RS-232 and RS-485. Both communication ports shall support all of the following baud rates: 9600, 19200, 38400, 57600 and 115200. Additionally, the RS-232 port shall be full-duplex and shall support true RTS/CTS hardware handshaking for interfacing to various communication devices.

Data Protocols. The RVSD shall support three different data protocols for all lanes being monitored: Interval (bin) data; Event (per vehicle) data; and Real-time True Presence data. The data protocol document shall be provided free of charge.

The Interval (bin) data packet protocol shall support:

- One detection zone or more of data per packet
- Sensor ID
- 32-bit time stamps in one second increments that indicate the end of time interval
- Total volumes of more than 65536 (necessary for time intervals greater than 10 minutes)
- Speed values in either Miles Per Hour or Kilometers Per Hour
- Occupancy in 0.1% increments
- Three types or more of vehicle classification in 0.1% increments

The Event (per vehicle) data packet protocol shall support:

- Sensor ID
- 32-bit time stamps in 2.5 ms increments or less that indicate the time the vehicle left the detection zone
- Speed values in either Miles Per Hour or Kilometers Per Hour
- Resolution of vehicle duration in the detection zone in 2.5 ms increments or less
- Five types or more of vehicle classification

The Real-time True Presence data packet protocol shall support:

- Sensor ID
- True presence information for each lane being monitored

Data Buffering. The RVSD shall buffer 200 or more Interval (bin) data packets that record volume, average speed, eighty-fifth percentile speed, occupancy and class for each detection zone with at least 10 zones per packet in volatile memory. The RVSD shall also backup 2400 or more Interval (bin) data packets into non-volatile memory.

Power Requirements. The RVSD will be installed at solar powered sites utilizing a 100 amp battery and two 60 watt solar panels and shall consume less than 10 watts with a DC input between 12 VDC and 28 VDC. The equipment shall be designed such that the failures of the equipment shall not cause the failure of any other unit of equipment. Automatic recovery from power failure shall be within 15 seconds after resumption of power.

The RVSD shall also include a graphical user interface software that displays all configured lanes and provides visual representation of all detected vehicles. The graphical interface shall operate on Windows CE, Windows 98, Windows 2000, Windows NT 4.0 and Windows XP Pro in the .Net environment. The software shall automatically select the correct baud rate and serial communication port from up to 15 serial communication ports. The software shall also operate over a TCP/IP connection and support a dial-up modem connection.

The operator shall be able to upload new firmware into non-volatile memory of the RVSD over any supported communication channel including TCP/IP networks. The software shall also give the operator complete control over the configuration process. The operator shall have the ability to save the configuration information to a file or reload the RVSD configuration from a file using the graphical user interface software. Using the installation software the operator shall be able to easily change the baud rate on the sensor by selecting baud rates from a drop-down list, as well as add response delays for the communication ports. Additionally, the operator shall have the ability to switch between data pushing and data polling, and change the RVSD's settings for Flow Control from none to RTS/CTS and vice versa.

RF Design. The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time. All transmit modulated signals shall be generated by means of digital circuitry, such as a direct digital synthesizer, that is referenced to a frequency source that is at least 50 ppm stable over the specified temperature range, and ages less than six ppm per year. Any upconversion of a digitally generated modulated signal shall preserve the phase stability and frequency stability inherent in the digitally generated signal. These specifications ensure that during operation the RVSD strictly conforms to FCC requirements and that the radar signal quality is maintained for precise algorithmic quality.

Field Training shall provide each trainee with the hands-on opportunity to install and configure the RVSD at roadside. Training shall be such that each trainee will be able to properly mount and align the RVSD correctly. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of devices should such services be required.

Documentation. The following documentation and specification test results shall be supplied by the manufacturer at the time of the bid submittal. Attached documents shall include the following:

- Auto-configuration documentation
- Volume accuracy data for both side-fire and forward-fire installations, including performance analyses for:
  - Free –flowing traffic
  - Congested traffic
  - Traffic with a lane roughly 10 ft. beyond concrete barrier
  - 20 foot and 190 foot lateral offset- simultaneous
- Average Speed accuracy test data for both side-fire and forward-fire
- Occupancy accuracy test data
- Vehicle classification test data
- EN 61000-4-5 Class 4 Lightning Surge Protection test results
- FCC CFR 47 certification
- NEMA 250 Standard for Type 4X Enclosure third-party test data
- NEMA TS2-1998 Standard third-party test data

Warranty. The RVSD shall be warranted to be free from material and workmanship defects for a period of two (2) years from date of shipment.

The unit shall have the ability to be managed remotely using a dial-up modem, CDPD wireless modem or a wired network/M connection. This means the unit can be configured, upgraded and monitored from a remote location.

All equipment and component parts furnished shall be new, be of the latest design and manufacture, and be in an operable condition at the time of delivery and installation. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer recommendations and standard practices.

Each vendor will provide a maximum of four (4) days training on software and equipment at Alabama Department of Transportation's facility in Montgomery, Alabama.

Vendor must supply four sets of manuals, and all cables, wiring harnesses and connectors necessary to install, operate and maintain equipment. A mounting bracket shall be provided to mount the unit. The mounting bracket shall be adjustable to allow the unit's pointing direction to be adjusted. This mounting bracket shall enable the unit to be fastened to a pole or signpost with the use of metal bands.

Each unit will be covered by a two-year warranty. Software and firmware upgrades will be provided for a period of five (5) years at no additional cost to the Alabama Department of Transportation.

Bid price to include delivery to Montgomery, Alabama.

Existing Traffic Data Retrieval System Requirements
Vehicle volume, classification and speed data will be retrieved from the units using the existing Traffic Data Retrieval System being utilized by the Traffic Monitoring Division of the Alabama Department of Transportation. This system was provided and is supported by the Wavetronix Company in Salt City, Utah. The successful vendor must provide Wavetronix the necessary communication protocols and any other information or assistance required for our TDRS to communicate and retrieve data from the counters using standard telephone communication modems via a standard telephone line or digital cellular telephone service. Contact Bryan Hagan, with Wavetronix, at 801-764-0277 ext. 1733 for specific details about the information needed.

Vendor must supply a test unit with operating and software manuals and any required software, cables and accessories needed to operate the equipment for a 30-day evaluation. Ship the test unit to:

Traffic Counter Repair
Alabama Department of Transportation
Transportation Planning Bureau
ATTN: Charles W. Turney,
511 Traffic Operations Drive
Montgomery, Al. 36110